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Abstract

URANIUM ALLOYS

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In connection with a study of uranium alloys, two mechanisms for improving the behaviour of metallic uranium under irradiation were examined.

The mechanism of grain refinement was investigated by studying the β/α transformation in dilute uranium alloys, and the γ phase stabilisation in high concentration alloys was studied by following the mechanism of $\gamma \rightarrow \alpha + \gamma'$ decomposition.

As regards the β/α transformation, both the rate of growth, G, and the rate of nucleation, N, were measured in several alloys [1], the former from the change in length of isothermally formed columnar grains.

It was found that the results could be expressed in terms of the Volmer-Turnbull theories of nucleation and growth. The interfacial energies $\sigma_{\alpha\beta}$ of the various alloys were calculated on this basis, both from nucleation and from growth, and were found to be of the same order of magnitude.

Assuming that linear extrapolation of the $\sigma_{\alpha\beta}$ values found for the various alloys to zero chromium is permissible, the value of the interfacial energy for pure uranium from both nucleation and growth measurements is 6 ergs/cm^2.

The appearance of columnar grains permitted the measurement of dihedral angles, whence could be calculated values of the ratio $\sigma_{\alpha\beta}/\sigma_{\alpha\alpha}$ where $\sigma_{\alpha\alpha}$ is the

interfacial α,α grain boundary energy.

The internal structure of these alloys was also examined, using super pure uranium for alloying. Clear pearlite structure was revealed, with characteristic "Hebrew Script" sub-lamellae.

An attempt was also made, taking the values of G and N, to calculate the overall transformation on the basis of the Johnson and Mehl theory.

The study of the $\gamma \rightarrow \alpha + \gamma'$ transformation was carried out on uranium high-molybdenum alloys using crystallographic techniques for determining the two TTT curves for the $\gamma \rightarrow \alpha$; $\gamma \rightarrow \gamma'$ transformation. It was found that both curves are strongly affected by small impurities, which may explain discrepancies in previous work.

REFERENCE

[1] BAR-OR, A., WYNBLATT, P., and HIRSCH, G., Nature 199 (1963) 585/586.